

REMARKS

Claim Objections

Claims 1-13 were objected to because, the Examiner stated, the term “effective” in claim 1 is a relative term which renders the claim indefinite. Claim 1 is being amended to recite a range of oxygen partial pressures corresponding to a preferred embodiment of the present method. This amendment is supported in the specification, *inter alia*, on page 8, lines 21-24. In view of this amendment, claim 12 is cancelled.

Rejections under 35 U.S.C. § 102

Claim 1 was rejected under 35 U.S.C. § 102(e) as being anticipated by Konakahara et al., U.S. Patent Publication 2002/0037249. This rejection is respectfully traversed. Konakahara discloses the use of conductive ZnO in an electrode in a photocell. Konakahara does not disclose ZnO as a semiconductor in a field effect transistor, or any process using a ZnO semiconductor.

Rejections under 35 U.S.C. § 103

Applicants submit that it is not clear from the Office Action whether claims 1, 2 and 7 were rejected under 35 U.S.C. § 103(a) as obvious over, or under 35 U.S.C. § 102(b) as being anticipated by, Giancaterina et al., in view of Kim. Because two documents are cited, Applicants assume the rejection was intended to be under 35 U.S.C. § 103(a). This rejection is respectfully traversed. As the Examiner has noted, Giancaterina discloses rf magnetron sputtering of ZnO, but not in a field effect transistor. Kim discloses the use of ITO as a pixel electrode in conjunction with a thin film transistor. Applicants submit that a pixel electrode is a conductor, not a semiconductor. The present claims relate to a process using a semiconductor. Accordingly, Applicants submit that the combination of Giancaterina and Kim does not disclose or suggest Applicants’ claimed invention.

Claims 3-6, 12 and 13 were rejected under 35 U.S.C. § 103 (a) as being unpatentable over Giancaterina. The Examiner stated that “these PVD processes (dc magnetron sputtering, diode sputtering, triode sputtering and ion beam sputtering) are well known in the art at the time of Applicant’s invention.” Applicants respectfully disagree. Applicants submit that Giancaterina lacks any disclosure of the process recited in present claim 1, including the ranges of oxygen partial pressure.

Applicants further submit that it is not generally known in the art that an undoped transparent metal oxide would have charge carrier mobilities and intrinsic

electrical conductivity appropriate for a semiconductor as obtained with the present process. In response to the Examiner's assertion that the determination of the preferred range of partial pressures of oxygen was a matter of routine experimentation, Applicants respectfully direct the Examiner's attention to the following passage from the specification (at page 4, line 20 through page 5, line 3):

"The good transport characteristics of the ZnO semiconductor of this invention, and prototypical of these TOS , include high electrical resistivity, for low device 'off' current combined with high charge carrier mobility for high 'on' device current. In the sputtered ZnO thin films of the present invention, the electrical resistivity is controlled by metering the partial pressure of oxygen during deposition. A novel aspect of our preparation of ZnO was the discovery that sputtering conditions favorable for achieving low ZnO film stress were also favorable for high transconductance and high on/off current ratio in ZnO TFT devices made at room temperature. It is believed the reason is that low stress ZnO films have fewer defects and a favorable electronic structure, which promote higher charge carrier mobility. Consequently, the ZnO films of the present invention exhibit better TFT device performance." (emphasis added).

The underlined portion highlights the unexpected advantage obtained in the process of the present invention. Applicants further direct the Examiner's attention to Figure 1, which shows resistivity as a function of partial pressure of oxygen. It can be seen that a change in partial pressure of about a factor of 2 from the critical pressure leads to a change in resistivity of about 10^6 . The effect can also be seen in Figure 2. Applicants submit that this effect was not known in the art prior to the time of Applicants' invention. Moreover, Applicants submit that the cited references, even in combination with general knowledge about PVD processes, do not suggest the unexpected effect observed by Applicants, namely that, by control of the oxygen partial pressure during deposition, it is possible to control the electrical conductivity of the undoped metal oxide. Accordingly, Applicants submit that claims 3-6 and 12-13 are patentable over Giancaterina in view of general knowledge of one of ordinary skill in the art at the time of Applicants' invention.

CONCLUSION

In view of the foregoing, Applicants submit that all of pending claims 1-11 and 13 are patentable over the art of record. Accordingly, withdrawal of the rejections and allowance of the above-referenced application is respectfully requested.

The Examiner is invited to telephone Applicants' undersigned representative to resolve any remaining issues.

Respectfully submitted,

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